Programmable Switching Clock with Sensor Inputs

Another winning project from our Flash Micro Competition

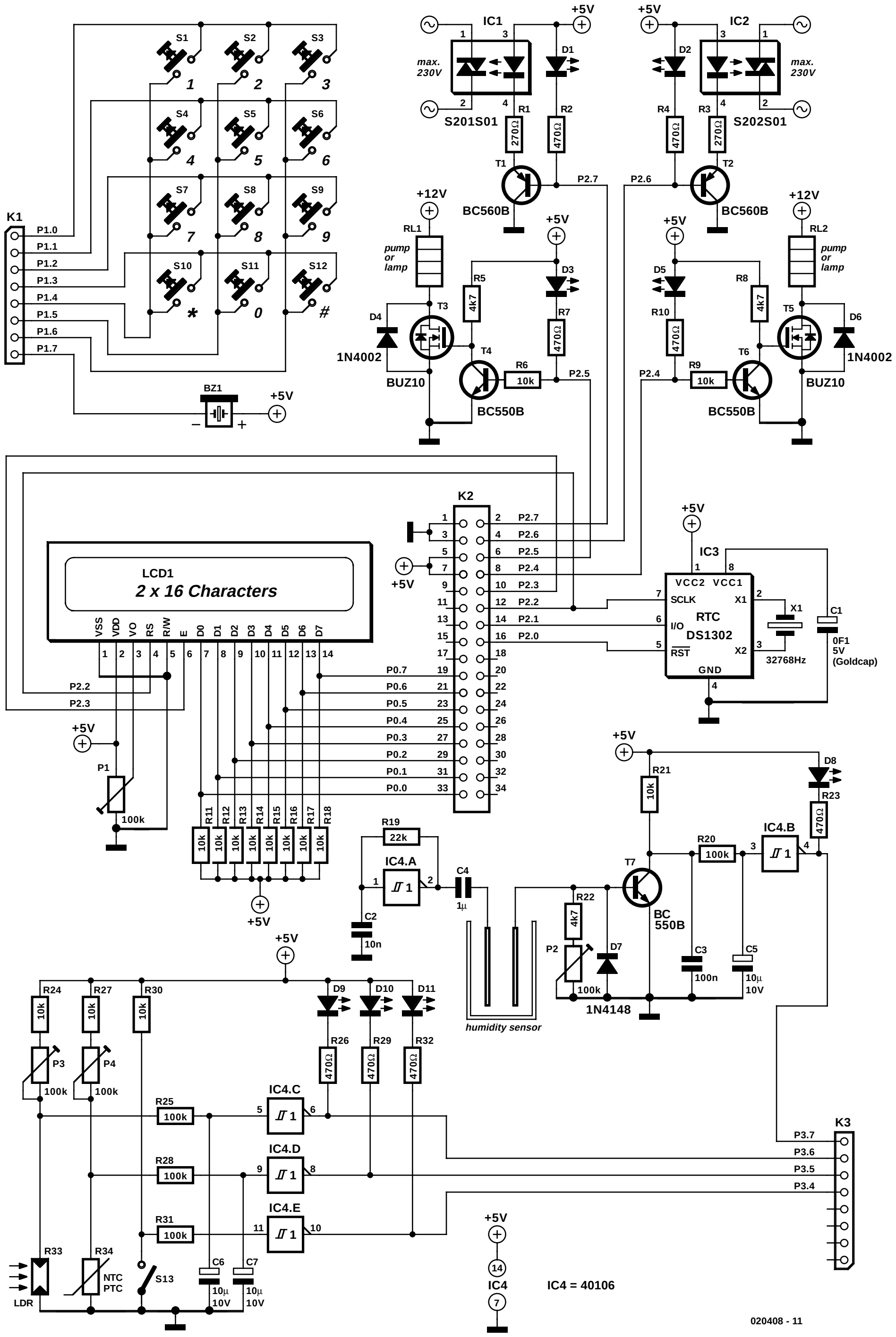

Figure 1. Peripherals strewn around the Flash Micro board: an LCD, an RTC and a keyboard matrix.

Design by W. Wätzig

Using a handful of external components our AT89S8252 Flash Micro board can be turned into a switching clock with sensor inputs and four switched outputs. The author demonstrates the programming of various inputs and outputs, aiming to control, for example, a small irrigation system.

The peripheral circuitry to add to the Flash Micro board consists of a (telephone) keypad connected as a matrix across port lines P1.0 through P1.6, a real-time clock type DS1302 (from Dallas Semiconductor) whose 3-wire bus is hooked up to port lines P2.0, P2.1 and P2.2, and, finally, a standard LC display with 2 rows of 16 characters. Thanks to the abundance of port lines on the 89S8252 controller, the LCD can be operated in 8-bit mode when connected to P0.0 through P0.7. The real-time clock chip supply is backed up using a 0.1-microfarad Goldcap to make sure the date & time information remains valid even when a (not too long) power cut occurs.

Two port lines have double occupation: the keyboard connection P1.6 doubles as an output to a buzzer, while the serial clock input of the RTC, P2.2 (CLK, pin 7 of the DS1302), is also taken to the data/control input (pin 4) of the LC display. Thanks to clever software programming, such double use of port lines does not present hardware conflicts or contention.

As an example, the Switching Clock may be used for an automated irrigation system in a conservatory, greenhouse or similar. External signals arriving by way of three Schmitt triggers may be processed, for example, supplied by the following sensors:

- a humidity sensor;
- an LDR as a twilight detector;
- an NTC/PTC for temperature measurement;
- a switch.

The outputs may be applied for:

- a 12-V switch using a power MOSFET energizing a lamp or a pump;
- a 230-V solid-state relay for heating control.

The inputs are connected to port lines P3.3 through P3.6, the outputs, to P2.2 through P2.7.

Process control statements

The switching clock may be used to execute up to nine process control ‘scripts’, stored in an EEPROM. The individual statements consists of logic combinations with this syntax:

```
<Output> =
(<Input1| Output1>
<and|or>
<Input2|Output2)
```

and

```
(Start-Time .. End-Time)
```

The microcontroller executes the process statements once a second and sets its outputs accordingly. For an irrigation system, process statements of the kind shown below may be used, provided, of course, the inputs and outputs are connected to the appropriate hardware.

```
when (DRY and WARM) and
TIME(16:00..20:00) then switch on PUMP
```

or

```
when (DARK and not PUMP) and
TIME(19:00..22:00) then switch on LAMP
```

In normal mode, the output ports are immediately controlled. In trigger mode, however, the system waits for the first time the condition (EAI */+ EA2) * TIME is satisfied. The time check may be disabled or switched to hourly.

All ports are internally interrogated and set as active-Low. The input ports are driven active-High externally because an inverting Schmitt trigger is inserted in the line. Although only available in German, The assembly code listing should prove a useful source of information when it comes to learning programming techniques for the 89C8252 micro. The relevant file may be downloaded free of charge from our website under number **020408-11.zip** (see month of publication).

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